**Florida**
**Power**
CORPORATION
Crystal River Unit 3
Docket No. 50-302

March 11, 1998
3F0398-02

U.S. Nuclear Regulatory Commission
Attn: Document Control Desk
Washington, D.C. 20555-0001

Subject: LICENSEE EVENT REPORT (LER) 50-302/98-003-00

Dear Sir:

Please find the enclosed Licensee Event Report (LER) 50-302/98-003-00. This LER discusses a loss of power to the Integrated Control System (ICS), which eventually caused a reactor trip. This report is being submitted pursuant to 10CFR50.73.

Sincerely,

T. H. Taylor
Acting Director
Nuclear Plant Operations

THT/pmp
Enclosures

xc: Regional Administrator, Region II
Senior Resident Inspector
NRR Project Manager

1141

NRC FORM 366 (4-95) U.S. NUCLEAR REGULATORY COMMISSION

APPROVED BY OMB NO. 3150-0104

EXPIRES 04/30/98

ESTIMATED BURDEN PER RESPONSE TO COMPLY WITH THIS MANDATORY INFORMATION COLLECTION REQUEST: 50.0 HRS. REPORTED LESSONS LEARNED ARE INCORPORATED INTO THE LICENSING PROCESS AND FED BACK TO INDUSTRY. FORWARD COMMENTS REGARDING BURDEN ESTIMATE TO THE INFORMATION AND RECORDS MANAGEMENT BRANCH (T-6 F33), U.S. NUCLEAR REGULATORY COMMISSION, WASHINGTON, DC 20555-0001, AND TO THE PAPERWORK REDUCTION PROJECT (3150-0104), OFFICE OF MANAGEMENT AND BUDGET, WASHINGTON, DC 20503.

# LICENSEE EVENT REPORT (LER)

| FACILITY NAME (1) | DOCKET NUMBER (2) | PAGE (3) |
|---|---|---|
| CRYSTAL RIVER UNIT 3 | 05000302 | 1 OF 7 |

TITLE (4)

Loss of Power to the Integrated Control System Caused a Trip of the Reactor

| EVENT DATE (5) | | | LER NUMBER (6) | | | REPORT DATE (7) | | | OTHER FACILITIES INVOLVED (8) | |
|---|---|---|---|---|---|---|---|---|---|---|
| MONTH | DAY | YEAR | YEAR | SEQUENTIAL NUMBER | REVISION NUMBER | MONTH | DAY | YEAR | FACILITY NAME | DOCKET NUMBER |
| 02 | 11 | 98 | 98 | -- 003 -- | 00 | 03 | 11 | 98 | FACILITY NAME | DOCKET NUMBER |

| OPERATING MODE (9) | 1 | THIS REPORT IS SUBMITTED PURSUANT TO THE REQUIREMENTS OF 10 CFR §: (Check one or more) (11) | | | |
|---|---|---|---|---|---|
| POWER LEVEL (10) | 100 | 20.2201(b) | 20.2203(a)(2)(v) | 50.73(a)(2)(i) | 50.73(a)(2)(viii) |
| | | 20.2203(a)(1) | 20.2203(a)(3)(i) | 50.73(a)(2)(ii) | 50.73(a)(2)(x) |
| | | 20.2203(a)(2)(i) | 20.2203(a)(3)(ii) | 50.73(a)(2)(iii) | 73.71 |
| | | 20.2203(a)(2)(ii) | 20.2203(a)(4) | X 50.73(a)(2)(iv) | OTHER |
| | | 20.2203(a)(2)(iii) | 50.36(c)(1) | 50.73(a)(2)(v) | Specify in Abstract below or in NRC Form 366A |
| | | 20.2203(a)(2)(iv) | 50.36(c)(2) | 50.73(a)(2)(vii) | |

LICENSEE CONTACT FOR THIS LER (12)

| NAME | TELEPHONE NUMBER (Include Area Code) |
|---|---|
| Patrick M. Peterson, Sr. Regulatory Specialist | (352) 795-6486 |

COMPLETE ONE LINE FOR EACH COMPONENT FAILURE DESCRIBED IN THIS REPORT (13)

| CAUSE | SYSTEM | COMPONENT | MANUFACTURER | REPORTABLE TO NPRDS | | CAUSE | SYSTEM | COMPONENT | MANUFACTURER | REPORTABLE TO NPRDS |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | |
| | | | | | | | | | | |

| SUPPLEMENTAL REPORT EXPECTED (14) | | EXPECTED SUBMISSION DATE (15) | MONTH | DAY | YEAR |
|---|---|---|---|---|---|
| YES (If yes, complete EXPECTED SUBMISSION DATE). | X NO | | | | |


ABSTRACT (Limit to 1400 spaces, i.e., approximately 15 single-spaced typewritten lines) (16)

On February 11, 1998, at approximately 0030, Florida Power Corporation's (FPC) Crystal River Unit 3 (CR-3) experienced a loss of power to the Integrated Control System (ICS), which eventually caused a reactor trip. The ICS was in AUTO when a loss of power caused the Main Feedwater pumps to run back to minimum speed. This caused the ATWS (Anticipated Transient Without SCRAM) Mitigating System Actuation Circuitry (AMSAC) to initiate the Emergency Feedwater System (EFW) and trip the turbine. The AMSAC is designed to actuate when indicated feedwater flow is less than 17 percent and reactor power is greater than 50 percent. The turbine trip Anticipatory Reactor Trip System (ARTS) is designed to trip the reactor automatically when the turbine trips and reactor power is greater than 45 percent. The plant responded as designed to a loss of power to the ICS. The root cause of the loss of power to the ICS was a zener diode not adequately soldered to the printed circuit board trace for the power supply monitor. FPC performed an evaluation of the reactor trip in accordance with Administrative Instruction (AI) AI-704, Reactor Trip Review and Analysis. The evaluation determined the plant responded as expected with minor equipment anomalies. The equipment anomalies were evaluated by FPC and corrected as appropriate. FPC replaced the ICS power supply monitor. FPC will perform a visual inspection of similar circuit boards installed in the plant during the next available outage.

| FACILITY NAME (1) | DOCKET | LER NUMBER (6) | | | PAGE (3) |
|---|---|---|---|---|---|
| | | YEAR | SEQUENTIAL NUMBER | REVISION NUMBER | |
| CRYSTAL RIVER UNIT 3 | 05000302 | 98 | - 003 - | 00 | 2 OF 7 |

**TEXT** *(If more space is required, use additional copies of NRC Form 366A)* (17)

## DESCRIPTION

On February 11, 1998, at approximately 0030, Florida Power Corporation's (FPC) Crystal River Unit 3 (CR-3) experienced a loss of power to the Integrated Control System (ICS) [JA], which eventually caused a reactor [RCT] trip. CR-3 was in MODE 1 (POWER OPERATION), operating at 99.7 percent RATED THERMAL POWER. Reactor coolant system (RCS) [AB] average temperature was 579 degrees Fahrenheit (F) and RCS pressure was 2150 pounds per square inch gauge. FPC informed the Nuclear Regulatory Commission of the event within four hours, event number 33692, pursuant to 10CFR50.72(b)(2)(ii). The RCS temperature initially stabilized at an average temperature of 551 degrees F, but was lowered and stabilized at an average temperature of 547 degrees F to re-seat Main Steam Safety Valve MSV-37.

The ICS was in AUTO when a loss of power caused the Main Feedwater [SJ,P] pumps to run back to minimum speed. This caused the ATWS (Anticipated Transient Without SCRAM) Mitigating System Actuation Circuitry (AMSAC) to initiate the Emergency Feedwater System (EFW) [SJ]. The AMSAC is designed to actuate when indicated feedwater flow is less than 17 percent and reactor power is greater than 50 percent. Approximately four seconds after the loss of 24 volt (V) Direct Current (DC) power to the ICS, feedwater flow had reduced to less than 17 percent indicated flow. Reactor power remained at 100 percent, and therefore AMSAC actuated as designed.

Upon actuation, the AMSAC is designed to cause a turbine trip as well as actuate the EFW. These actions occurred within one second of the AMSAC actuation. The turbine Anticipatory Reactor Trip System (ARTS) is designed to trip the reactor automatically when the turbine trips and reactor power is greater than 45 percent. Reactor power remained at 100 percent, and therefore the reactor tripped as designed. All control rods fully inserted and all safety systems functioned as required. The EFW system actuated and supplied water to both Once Through Steam Generators (OTSGs) as designed.

At the time of the trip, there were no ongoing maintenance activities on the ICS.

Minor anomalies were noted with the EFW system response. These anomalies did not prevent the EFW system from performing its design function, and the anomalies were evaluated and determined to be acceptable or corrected prior to startup, following the reactor trip.

When the 24 V DC power to the ICS was lost, control of the Turbine Bypass Valves also was lost. These valves failed closed, as designed, on loss of control power. Steam pressure in the OTSGs was controlled via the Main Steam Safety Valves. Approximately 30 minutes following the reactor trip, the Atmospheric Dump Valves (powered independently of ICS) were used to control OTSG steam pressure and to re-seat the Main Steam Safety Valves.

This event was determined to be reportable pursuant to 10CFR50.73(a)(2)(iv).

| FACILITY NAME (1) | DOCKET | LER NUMBER (6) | | | PAGE (3) |
|---|---|---|---|---|---|
| | | YEAR | SEQUENTIAL NUMBER | REVISION NUMBER | |
| CRYSTAL RIVER UNIT 3 | 05000302 | 98 | -- 003 - | 00 | 3 OF 7 |

**TEXT** *(If more space is required, use additional copies of NRC Form 366A)* **(17)**

## EVALUATION

The basic function of the ICS is matching megawatt generation to Unit Load Demand (ULD). The ICS has two different types of power supplies. One power supply is a 120 V Alternating Current (AC), used to supply field loads. The 120V AC receives power through two Vital Bus Distribution Panels (VBDP), VBDP-2 and VBDP-4. VBDP-4 is the preferred power supply; however, in the event of a voltage drop, an automatic bus transfer device will swap the power source. The ICS also has two positive and two negative 24 V DC power supplies. These power supplies convert the 120 V AC input to a positive/negative 24 V DC output. Through current sharing circuits, the 24 V DC power supplies provide a positive and negative DC power bus. The DC power busses provide the power to the ICS control cabinets. The redundant power supplies allow the busses to be supplied from either VBDP and can withstand the loss of one positive and one negative power supply without a loss of system function.

The ICS also includes a power supply monitor to monitor the 24 V DC power supplies and power busses for failure. If the voltage from the power supplies drops below the setpoint, the monitor provides an indication and an annunciator alarm. If the bus voltage drops below the setpoint, the power monitor will open the breakers [BKR] from the VBDPs, which will cause a total loss of DC power to the ICS cabinets. The power to the ICS cabinet was lost when the breakers S1/S2 from the VBDPs opened. The breakers opened on a low voltage indication from the power supply monitor. Prior to the trip, annunciator alarms for a low voltage condition on 24 V DC bus entered and cleared 10 times. The alarms entered and cleared in approximately 15 milli-seconds (ms). The low voltage indication alarm would have to stay in for approximately 45 ms in order to trip the breakers. These indications were believed to be a precursor to the failure of the power supply monitor.

The loss of power to the ICS cabinet resulted in the plant going to a known-safe-state, which is the preferable condition the plant would go to for various failures, such as ICS power supply anomalies. A number of previous loss of ICS power events at Babcock & Wilcox plants demonstrated that partial power losses could produce adverse results. While this current failure was associated with the monitor and not the power supplies, the resulting plant condition was appropriate from an overall safety perspective.

## CAUSE

The loss of ICS power eventually caused the reactor trip. The root cause of the loss of power to the ICS was a zener diode not adequately soldered to the printed circuit board trace for the power supply monitor that connected it to the common of the positive 24 V DC Bus. The zener diode break down voltage establishes the reference voltage being supplied to the integrated circuit amplifier that causes the actuation of a relay which activates the 24 V ICS Bus Failure annunciator and trips the 24 V DC power supply input breakers, S1/S2.

FPC had repaired the zener diode on the printed circuit board prior to 1994. Prior to installation into the power supply monitor in 1996, the printed circuit board was tested and found to be satisfactory and thereby, acceptable for use. FPC failed to adequately inspect the printed circuit board for unacceptable workmanship prior to installing the board in the power supply monitor.

## IMMEDIATE CORRECTIVE ACTIONS

Emergency Operating Procedure (EOP) EOP-02, Vital System Status Verification, was entered and all required actions were completed. EOP-10, Post Trip Stabilization, was entered at the completion of EOP-02. All required actions for EOP-10 were completed and EOP-10 was exited approximately two hours after the reactor trip. CR-3 stabilized in MODE 3 (HOT STANDBY) in accordance with Operating Procedure (OP) OP-209, Plant Cooldown.

## CORRECTIVE ACTION

FPC performed an evaluation of the reactor trip in accordance with Administrative Instruction (AI) AI-704, Reactor Trip Review and Analysis. The evaluation determined the plant responded as expected with minor equipment anomalies. The equipment anomalies were evaluated by FPC engineering and corrected as appropriate. FPC replaced the ICS power supply monitor.

## ACTIONS TO PREVENT RECURRENCE

FPC will perform a visual inspection of similar circuit boards installed in the plant during the next available outage. FPC currently provides training for technicians on the proper technique and procedure to repair and modify printed circuit boards for safety and non-safety related applications.

## PREVIOUS SIMILAR EVENTS

FPC has previously reported one other event regarding a loss of power to the ICS. The details of that event are identified in LER 50-302/91-016-00.

| FACILITY NAME (1) | DOCKET | LER NUMBER (6) | | | PAGE (3) |
|---|---|---|---|---|---|
| | | YEAR | SEQUENTIAL NUMBER | REVISION NUMBER | |
| CRYSTAL RIVER UNIT 3 | 05000302 | 98 | -- 003 -- | 00 | 5 OF 7 |

**TEXT** *(If more space is required, use additional copies of NRC Form 366A)* **(17)**

## ATTACHMENTS

Attachment 1 - Abbreviations, Definitions, and Acronyms
Attachment 2 - Commitments

## ATTACHMENT 1

## ABBREVIATIONS, DEFINITIONS, AND ACRONYMS

| | |
|---|---|
| 10CFR | Title 10 of the Code of Federal Regulations |
| CR-3 | Crystal River Unit 3 |
| FPC | Florida Power Corporation |
| LER | Licensee Event Report |
| ICS | Integrated Control System |
| RCS | Reactor Coolant System |
| ATWS | Anticipated Transient Without SCRAM |
| AMSAC | ATWS Mitigating System Actuation Circuitry |
| DC | Direct Current |
| V | Volt |
| ARTS | Anticipatory Reactor Trip System |
| OTSG | Once Through Steam Generator |
| ULD | Unit Load Demand |
| AC | Alternating Current |
| VBDP | Vital Bus Distribution Panel |
| ms | millisecond |
| EOP | Emergency Operating Procedure |
| OP | Operating Procedure |
| SP | Surveillance Procedure |
| AI | Administrative Instruction |
| F | Fahrenheit |
| EFW | Emergency Feedwater System |

Note: Improved Technical Specifications terms appear in capitalization in the text of the LER. EIIS Codes appear in square brackets. Defined terms/acronyms/abbreviations appear in parentheses when first used.

| FACILITY NAME (1) | DOCKET | LER NUMBER (6) | | | PAGE (3) |
|---|---|---|---|---|---|
| | | YEAR | SEQUENTIAL NUMBER | REVISION NUMBER | |
| CRYSTAL RIVER UNIT 3 | 05000302 | 98 | -- 003 -- | 00 | 7 OF 7 |

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## ATTACHMENT 2

| RESPONSE SECTION | COMMITMENT | DUE DATE |
|---|---|---|
| Page 4 | FPC will perform a visual inspection of similar circuit boards installed in the plant during the next available outage. | Next Available Outage |

# CATEGORY 1

REGULATORY INFORMATION DISTRIBUTION SYSTEM (RIDS)

ACCESSION NBR:9803130332 DOC.DATE: 98/03/11 NOTARIZED: NO DOCKET #
FACIL:50-302 Crystal River Nuclear Plant, Unit 3, Florida Power Co 05000302
AUTH.NAME AUTHOR AFFILIATION
PETERSON,P.M. Florida Power Corp.
TAYLOR,T.H. Florida Power Corp.
RECIP.NAME RECIPIENT AFFILIATION

SUBJECT: LER 98-003-00:on 980211,loss of power to integrated control sys occurred.Caused by zener diode not adequately soldered to printed circuit board trace for power supply monitor. FPC replaced ICS power supply monitor.W/980311 ltr.

DISTRIBUTION CODE: IE22T COPIES RECEIVED:LTR 1 ENCL 1 SIZE: 8
TITLE: 50.73/50.9 Licensee Event Report (LER), Incident Rpt, etc.

NOTES:

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| INTERNAL: | ACRS | 1 | 1 | AEOD/SPD/RAB | 2 | 2 |
| | AEOD/SPD/RRAB | 1 | 1 | FILE CENTER | 1 | 1 |
| | NRR/DE/ECGB | 1 | 1 | NRR/DE/EELB | 1 | 1 |
| | NRR/DE/EMEB | 1 | 1 | NRR/DRCH/HHFB | 1 | 1 |
| | NRR/DRCH/HICB | 1 | 1 | NRR/DRCH/HOLB | 1 | 1 |
| | NRR/DRCH/HQMB | 1 | 1 | NRR/DRPM/PECB | 1 | 1 |
| | NRR/DSSA/SPLB | 1 | 1 | NRR/DSSA/SRXB | 1 | 1 |
| | RES/DET/EIB | 1 | 1 | RGN2 FILE 01 | 1 | 1 |
| EXTERNAL: | L ST LOBBY WARD | 1 | 1 | LITCO BRYCE,J H | 1 | 1 |
| | NOAC POORE,W. | 1 | 1 | NOAC QUEENER,DS | 1 | 1 |
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C A T E G O R Y 1 D O C U M E N T

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